Secretary's Scientific Advisory Board on Toxic Air Pollutants Review of Mercury
Atmospheric Fate and Transport of Mercury
December 5, 2000

Executive Summary

In December of 1998, the North Carolina Department of Health and Human Services requested that the NC DENR Secretary's Scientific Advisory Board on Toxic Air Pollutants (SAB) consider the likelihood and magnitude of indirect (i.e. non-inhalation) environmental exposures to mercury that could result from industrial emissions to the air. Staff of the DENR and DHHS collaborated to develop a five-part plan for this review, involving consideration of the toxicity, potential for exposure and environmental fate and transport of mercury. In this stage of their review the SAB considered factors that influence the atmospheric fate and transport of mercury emitted to the air.

Mercury is emitted to the air by both natural and man-made sources. Natural emissions arise from degassing of the earth's crust, volcanic activities, forest fires and volatilization from plants and waterbodies. Man-made emissions of mercury commonly originate from industrial uses of mercury, waste incineration, or the combustion of organic material and fuels containing trace quantities of mercury as a contaminant. Major categories of anthropogenic emissions sources in North Carolina include coal-fired electric utility boilers, industrial boilers and waste incinerators.

Mercury emitted to the air behaves according to its physicochemical characteristics. Elemental mercury vapor, the predominant form of mercury in air, is subjected to long-range transport by virtue of its high vapor pressure and lack of water solubility. Elemental mercury undergoes global-scale transport before returning to the earth's surface. Mercury also exists in ambient air in the mercuric state Hg^{2+} as reactive gaseous mercury. These forms will associate with atmospheric waters and particulate matter and deposit to the earth's surface relatively rapidly. Gas-phase and aqueous atmospheric reactions involving mercury may also affect atmospheric residence time. Oxidation of elemental mercury to reactive gaseous mercury may enhance atmospheric deposition while reduction of Hg^{2+} to elemental mercury would increase atmospheric residence time.

Under most circumstances, emissions of elemental mercury will be subjected to long-range atmospheric transport. Conversely, emissions of reactive gaseous or particulate mercury may contribute to local-scale deposition. Atmospheric deposition of mercury will increase the load of mercury in lakes and rivers and may subsequently increase mercury levels in fish and other aquatic organisms. Reducing mercury emissions from sources that emit reactive gaseous or particulate mercury should result in reduced local and regional-scale delivery of mercury to land and surface waters. Although considerable uncertainty remains, it is believed that reducing inputs of mercury to these systems will eventually result in a reduction in fish methylmercury levels and resulting human exposures.